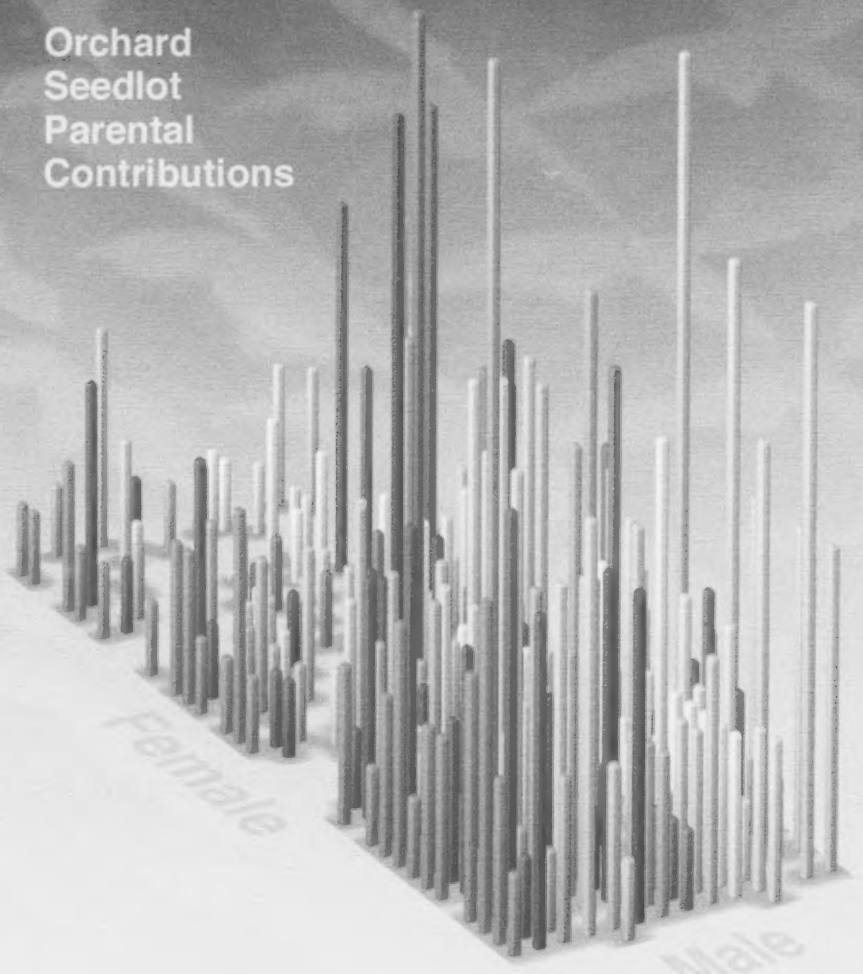
FGC Forest Genetics Council of British Columbia

ANNUAL REPORT 2010/2011

Orchard
Seedlot
Parental
Contributions



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Cover graphic:
Male and female parental contributions to a seedlot from a western larch seed orchard

The cover figure illustrates male and female contributions to a seedlot from orchard parents in a western larch seed orchard. Each column shows the relative contribution of parents to a specific full-sib family.

DNA fingerprinting can verify the parental contributions and level of non-orchard pollen and seed from an orchard crop. Research initiated with funding through the Forest Genetics Council of BC, and in collaboration with private and public seed orchards operators and the Forest Sciences Department of the University of British Columbia, used DNA-fingerprinting and paternity analyses to determine reproductive success and rates of non-orchard pollen intrusion to seed orchards. While both maternal (seed) and paternal (pollen) contributions to a seedlot can be estimated using survey techniques, these techniques have unknown error levels. Seed samples from various species and different years were used to better understand the reproductive dynamics in seed orchards and to evaluate the accuracy of survey techniques. Ultimately, the use of quick and low-cost surveys is the preferred means for estimating parental success, but the correlation of more accurate DNA data with a variety of survey techniques will lead to a better survey methodology.

This work is being led by Dr. Yousry El-Kassaby and Thomas Funda in the University of British Columbia Department of Forest Sciences.

Overview and acknowledgements

JACK WOODS,
Program Manager,
Forest Genetics
Council of BC

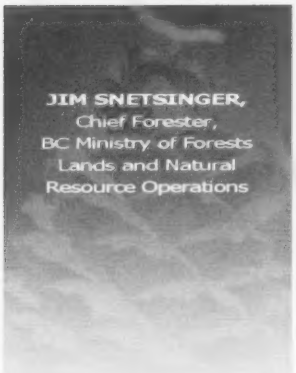
Performance measures for provincial-level objectives outlined in the Forest Genetics Council (FGC) Strategic Plan for 2009 to 2014 are presented here for the 2010/11 fiscal year. Included are financial summaries for spending under the Land Based Investment Strategy (LBIS) Tree Improvement Program. Further details are available in the FGC Business Plan for 2010/11, and the Tree Improvement Program Projects Report for 2010/11. This is the 10th consecutive Annual Report of the FGC.

The past year was noteworthy for large seed orchard crops, including continued increases in lodgepole pine supply. Average genetic worth of crops also continued to rise, with several very high genetic worth seedlots produced for interior Douglas-fir, interior spruce, and western larch. 2010 also saw the implementation of climate-based seed transfer standards for western larch that will allow limited movement of this species to areas exhibiting suitable climate that lie outside its current natural range. Focus on climate-based seed transfer will result in more such changes in future years as BC adjusts to climate change and as we pursue opportunities to maintain forest resilience and productivity.

Under the able leadership of co-chairs Brian Barber (MFLNRO) and Kerry McGourlick (Western Forest Products Inc.), the FGC continues to effectively lead the broad range of genetic resource management and tree improvement efforts in BC. All involved are thanked for their support and work during the year, in particular Coast and Interior TAC chairs Annette van Niejenhuis and Tim Lee, Genetic Conservation TAC chair Dave Kolotelo, Pest Management TAC chair Jim Corrigan, Extension TAC chair Diane Douglas, and Lee Charleson, chair of the Seed Transfer TAC and the Genetic Resource Decision Support Steering Committee.

Provincial Chief Forester Jim Snetsinger and Susanna Laaksonen-Craig, Executive Director, Resource Stewardship Division, are also thanked for their ongoing support and guidance.

Photo credits: D. Kolotelo, J. Woods



JIM SNETSINGER,
Chief Forester,
BC Ministry of Forests
Lands and Natural
Resource Operations

Message from the Chief Forester

I am pleased to present the 10th annual report of the Forest Genetics Council of BC. Council has made great progress over the past decade in advancing its goals for increasing the use and value of select seed. The 2010 seed orchard crop was the second largest in the history of the provincial tree improvement program . In 2011, 140 million seedlings, or 64% of the 240 million seedlings requests, utilized select seed with an average genetic gain of 16%. These figures demonstrate that we are well on track to meet FGC's long-term targets. Congratulations to all involved for these successes.

2010-11 was also a year of change. Government reorganized its natural resource ministries. As a result, the Forest Genetics Section of the former Research Branch was amalgamated with Tree Improvement Branch. These changes served to strengthen relationships between the mutually-dependent business areas of research, policy, and operations. Also, a number of senior and highly respected members of our tree improvement community retired or left this past year. Their knowledge and expertise will be difficult to replace. These changes highlight the need for succession planning in both the public and private sectors to ensure that our organizations will remain as productive and resilient as our future forests.

Governments (provincial and federal), the private forest sector and universities have worked together for over 50 years to enhance the value, resilience and conservation of BC's forest genetic resources. This collaborative effort continued irrespective of the recent changes and departures. FGC's programs therefore remain as strong and significant contributors to government's goal of BC becoming a world leader in growing trees and maximizing the productivity of forests resources.

On behalf of government, I would like to thank councilors, affiliated members on its several technical advisory committees, and the forest genetics community-at-large, for their contributions and service.

Message from Forest Genetics Council Co-Chairs

BRIAN BARBER and KERRY McGOURLICK,
Co-Chairs,
Forest Genetics
Council of BC

2010/11 was a banner year for the FGC. The use of select seed increased substantially in 2011 due to a rebound in forest harvesting and reforestation activities, and consequently, seedling requests. The higher percentage of select seed use (64%) is also attributed to the increased seed production in BC's lodgepole pine orchards, accounting for 45 million of the 240 million seedlings requested in 2011. Interior spruce however remains the most utilized select seed species in the province. These statistics, and others, are highlighted in series of new graphs within this report.

Government and stakeholder support of FGC's tree improvement program remained strong in 2010/11. FGC's programs were the most significant contributor to government's performance measure for incremental silviculture investments. We are grateful for the recognition and funding provided by the Chief Forester's Office and the Land Based Investment Strategy.

Advancements in seed transfer research and policy (e.g. assisted migration adaptation trial and range expansion of western larch) and pest resistance breeding (e.g. deer browse resistant redcedar), also attracted professional and public interest this past year. These and other activities supported by the FGC serve to demonstrate that BC remains a world leader in forest genetic resource management and conservation.

We would also like to thank all those who have contributed to the goals and activities of council over the past decade, especially those who retired or departed in 2010/11. You leave behind a legacy that will benefit future generations. In closing, we'd like thank Jack Woods, Program Manager, for his diligent organization, planning and reporting on FGC business. FGC's success would not be possible without Jack's knowledge, skills, and service.

We encourage readers of this annual report to also review the forthcoming 2010/11 FGC Tree Improvement Program Project Report for further information and details about FGC projects and people.

The FGC Annual Report presents provincial-level performance indicators.

1.0 Introduction

This Annual Report presents provincial-level performance indicators outlined in the FGC Strategic Plan for 2009 to 2014. It also summarizes outcomes from Land-Base Investment Strategy (LBIS) Tree Improvement Program-funded projects that are outlined in the Forest Genetics Council of BC (FGC) Business Plan for 2010/11. Performance indicators reported here represent results from both LBIS investments and the investment of other cooperators.

1.1 Tree improvement and forest genetic resource management in British Columbia

Tree improvement and forest genetic resource management (GRM) include increasing value through tree breeding and seed production, conservation of the genetic diversity of indigenous forest tree species, and enhancing forest resilience through scientifically-based seed transfer standards and the maintenance of genetic diversity.

1.2 About the Forest Genetics Council of British Columbia

The Forest Genetics Council is a multi-stakeholder group representing agencies and companies who are stakeholders in managing and conserving the genetic resource of indigenous tree species.

The FGC is a multi-stakeholder group representing government agencies (Ministry of Forests Lands and Natural Resource Operations (MFLNRO), the Canadian Forest Service, the forest industry, universities, and non-industrial private companies. The mandate of the FGC is to champion forest GRM, to oversee strategic and business planning for a cooperative provincial GRM program, and to advise the provincial Chief Forester on GRM policies.

The FGC acts as a forum through which stakeholders cooperate in program development, lead business planning for provincial investments through the LBIS Tree Improvement Program, and seek efficiencies for all investments, including those by industry and university cooperators.

1.3 FGC vision and objectives

Council set the following vision statement and objectives in its five-year Strategic Plan (2009-2014), and annually develops a Business Plan outlining activities to meet these objectives.[1]

[1] For more information on the Forest Genetics Council, see *http://www.fgcouncil.ca.*

Vision

BC's forest genetic resources are diverse, resilient, and managed to provide multiple values for the benefit of present and future generations.

Objectives

- *Increase the average volume gain of select seed used for Crown land reforestation to 20% by the year 2020*
- *Increase select seed use to 75% of the provincial total sown by 2014*
- *Adequately conserve the genetic diversity of key populations of all forest tree species native to BC by 2015, through a combination of in situ, ex situ, and inter situ conservation*
- *By 2020, high-quality genecology research information will guide operationally efficient climate-based seed transfer policy and practice for all trees planted in BC*
- *Coordinate stakeholder activities and secure the resources needed to meet Business Plan priorities*
- *Monitor and report progress in genetic resource management activities*

Departures during 2010/11

Dr. John King

Scientist and tree breeder with the MFLNRO leading the Sitka spruce and coastal white pine programs from 1990 to 2010.

Dr. Robb Bennett

Orchard pest management specialist with the MFLNRO from 1992 to 2010. Chair of the cone and seed pest management TAC from 2005 to 2010.

Keith Cox

Skimikin Seed Orchard (MFLNRO) manager. With the Ministry from 1977 to 2011.

Carolyn Lohr

Saanich Seed Orchard manager (MFLNRO). With the Ministry from 1992 to 2010.

Patti Brown

Sechelt Seed Orchard manager with Canadian Forest Products Ltd. from 1992 to 2010.

Ray Cardy

Bowser Seed Orchard manager (MFLNRO). With the Ministry from 1992 to 2010.

Helga Mehl

Genetics technician at the MFLNRO Glyn Road Lab from 1982 to 2010.

2.0 Budget and Expenditures

Land Based Investment Strategy Tree Improvement Program allocations and expenditures for the 2010/11 fiscal year are shown in Table 1. The table does not include in-kind costs, staff salaries, and other substantial inputs by industry, MFLNRO, and university cooperators who contribute to the success of GRM activities in BC.

Table 1
Summary of Forest Investment Account Tree Improvement program budgets and expenditures for the period April 1, 2010 through March 31, 2011 ($ x 1000).

Subprogram	Budget ($)	Expenditures ($)
Genetic Conservation	248	243
Tree Breeding	1,141	1,074
Operational Tree Improvement Program (OTIP)	684	559
Extension and Communication	20.5	13
Genetic Resource Decision Support	0	0
Cone and Seed Pest Management	162	151
Genecology and Seed Transfer	436	362
Administration	30	19
Incremental projects	143.5	143.5
Applied Tree Imp. and Biotechnology (UBC)	122	122
SelectSeed Ltd. orchards and FGC program management	543	543*
Total	**3,530**	**3,229.5**

* SelectSeed allocation shown. Total SelectSeed expenditures were $996,500 with the difference supported through seed sale revenue and investment income.

Expenditures fell short of budgets primarily due to a broad provincial government response to significant revenue shortfalls and the implementation of spending and contract restrictions that delayed and resulted in the cancellation of some time-sensitive field work. This mostly impacted the Tree Breeding and Genecology subprograms. Some approved seed orchard projects in the OTIP subprogram were not implemented due to smaller-than-expected crops. In general, however, work proceeded as planned and the project leaders in all subprograms worked to ensure priority work was completed.

3.0 Performance Indicators

Progress towards objectives set out in the FGC Strategic Plan for the period 2009-2014 (summarized above) are measured and reported annually. Two of these objectives are to increase select seed use to 75% and increase the average genetic worth (GWg[2]) of class A select seed to 20%. Province-wide performance on these objectives has been measured and reported since 2000 and is shown below.

3.1 Increase seedlot genetic worth

Objective

Increase the average volume gain of select seed used for Crown land reforestation to 20% by the year 2020

Performance

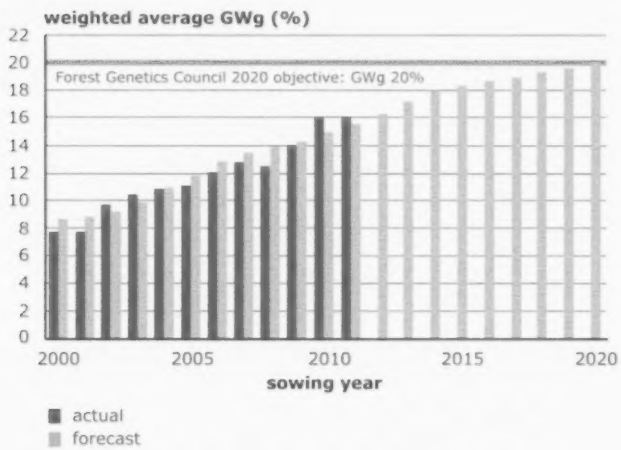


Figure 1
Annual actual and forecast average genetic worth for stem-volume growth (GWg) of select seed sown in BC

Genetic worth for growth (GWg) remained at a provincial average of 16%, after a substantial increase in the 2010 sowing year (Figure 1). The trend to higher-gain seed production in provincial orchards continues, with large seedlots of high GWg interior spruce and western larch now available. High-gain interior Douglas-fir is also increasing in availability as a result of ongoing investments in breeding programs and the Operational Tree Improvement Program (OTIP), which support upgrading orchards with parent trees of high breeding value.

[2] Genetic worth is a measure of rotation-age gain in a specific trait, relative to non-selected wild seed. Genetic worth for growth (GWg) is a measure of stand-based gains in wood volume expressed as a percentage.

3.2 Increase select seed use

Objective

Increase select seed use to 75% of the provincial total sown by 2014

Performance

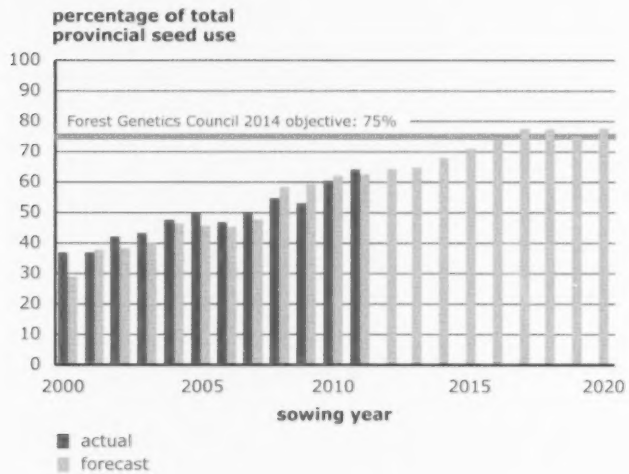


Figure 2
Actual and species-plan forecasts of select-seed use as a percentage of total provincial seed use by year.

Select seed use as a percentage of total sowing has increased substantially in the past two years, from 53 percent in the 2009 sowing year to 60 percent in 2010, and 64 percent in 2011 (Figure 2). This increase is due primarily to greater supply and use of lodgepole pine, as well as interior Douglas-fir orchard seed. For 2011, there was also a substantial increase in sowing for western redcedar on the coast relative to the previous two years. Overall provincial sowing rebounded from a low of 181 million in 2010 to 242 million in 2011 (Crown and private land). Figures 3 and 4 provide a breakdown of annual sowing by species and genetic class.

Provincially, the overall use of orchard seed jumped to a new high level of 140 million trees, eclipsing the previous high of 119 million in 2007, even though overall provincial sowing remained below the highs of 2006 and 2007. These upward trends in both GWg and the overall use of orchard seed are led by increasing production from lodgepole pine seed orchards. Lodgepole pine has the advantage of producing crops nearly every year, but crops are modest relative to the very high and periodic production levels that can be experienced with spruce, Douglas-fir and larch. Orchard managers are gaining experience with the management of lodgepole pine orchards, but meeting overall production targets continues to be a challenge.

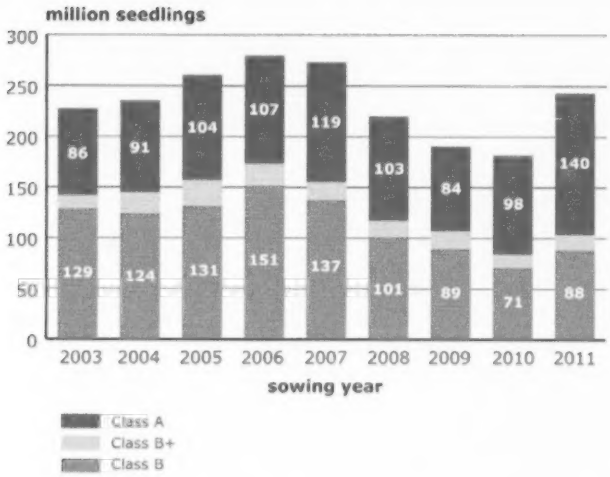


Figure 3
Provincial sowing of orchard (class A), wild-stand (class B), and superior provenance seed (class B+) from 2003 to 2011.

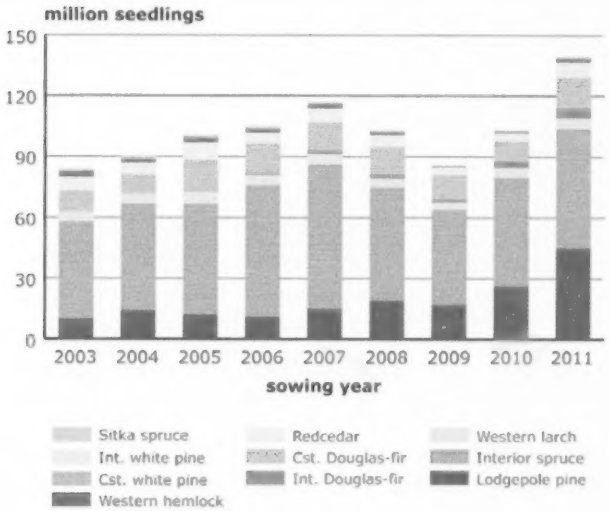


Figure 4
Provincial sowing of orchard seed (class A) by species from 2003 to 2011.

Ready for cone harvest at the Kettle River Seed Orchard Company lodgepole pine orchard operated under contract to Council-owned SelectSeed Ltd. *(J. Woods photo)*

Feature

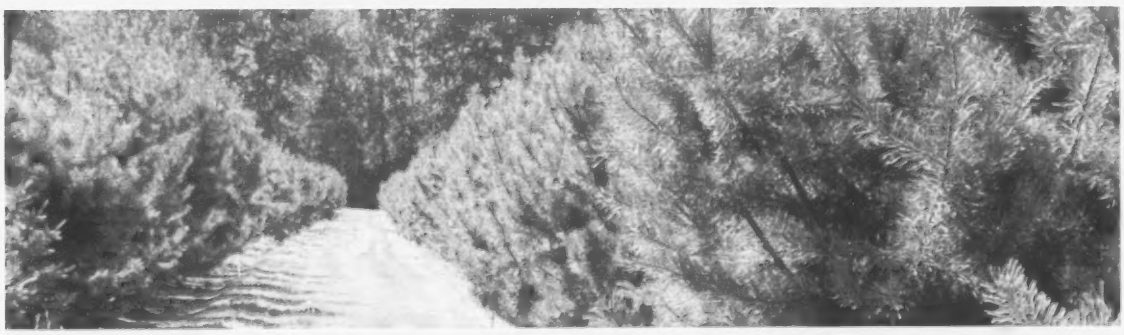
FGC-owned SelectSeed Co. Ltd. meets seed production objectives

In 1999, the Forest Genetics Council was presented with an opportunity requiring out-of-the box thinking. Having set a new provincial objective for the use of select seed (this objective still stands today; see figure 2) it was evident that seed orchard expansion was needed; particularly for lodgepole pine. At the time, Forest Renewal BC (FRBC) was seeking investment that would positively contribute to timber supply and quality on Crown land. To take advantage of this opportunity, the FGC created SelectSeed Co. Ltd. and structured ownership through the BC Forest Genetics Society to ensure the company would be controlled by Council and that any net revenues could only be used to support tree improvement investments on Crown lands.

Under the oversight of a board of directors reporting to the FGC, SelectSeed developed a business plan and negotiated a long-term contract with FRBC that provided capital for seed orchard development with provision for the repayment of capital when seed sales resulted in positive net revenue. SelectSeed's business plan set out an ambitious schedule to develop seed orchards to help meet FGC objectives. As SelectSeed is wholly owned by the FGC, Council set the expectation that the Company would also provide management services for Council, including business planning and reporting, meeting organization, facilitating committees reporting to Council, providing analysis, and representing Council on various issues.

Starting in 2000, SelectSeed negotiated long-term seed orchard agreements with five companies for the development of 14 seed orchards with over 35,000 ramets. Grafting was undertaken with advice from BC Forest Service tree breeders to ensure parent trees of the highest possible genetic quality were used. Orchards were then developed and planted on a large scale. A decade later, all 14 seed orchards are producing and over 1,000 hectoliters of cones have been harvested, yielding 470 kilograms of seed capable of producing over 65 million seedlings of high genetic worth. Nearly all seed has been sold to over 70 clients, including forest companies, BC Timber Sales, community forests, first nations, and woodlot licensees. The original SelectSeed business plan forecast total seed sales by March 2011 of $1.3 million; actual sales to date are $1.26 million, with additional seed in inventory. Production continues to ramp up in these young orchards and it is expected SelectSeed will begin returning capital to the FGC and the MFLNRO within the next 5 years.

This success story is a testament to the vision of FGC members who structured it in 1999, to consistent support from subsequent FGC members, and to the knowledge and experience of orchard staff who have kept orchards on track over the past decade.



SelectSeed orchards - Top: Picking cones for the Thompson Okanagan zone at the Pacific Regeneration Technologies Ltd. site *(J. Woods photo)* **Middle:** A developing spruce crop at the Tolko Ltd. site *(G. Pieper photo)*. ***Bottom:*** Lodgepole pine seed orchard at the Kettle River Seed Orchard Ltd. site. This 11 hectare orchard is now producing high genetic worth seed for the Prince George seed zone *(J. Woods photo)*.

3.3 Adequately conserve genetic diversity

Objective

Adequately conserve the genetic diversity of key populations of all forest tree species native to BC by 2015, through a combination of *in situ*, *ex situ*, and *inter situ* conservation

Performance

All 50 tree species indigenous to BC are included in genetic conservation monitoring. Models based on inventory data were used to estimate *in situ* conservation status for each species within each biogeoclimatic zone[3]. For commercial species, reporting includes the *in situ*, *inter situ*, and *ex situ*[4]conservation status of tree populations by seed planning unit.

During the period of this report, ground truthing in high priority areas was undertaken to compare population sizes predicted by inventory-based models with actual population inventories observed through field sampling. Comparisons were made at various spatial scales; from individual protected areas to biogeoclimatic zones. Results indicate that the models tend to underestimate the abundance of major timber species, which were typically very well conserved. However, due to less comprehensive inventory data, the models tend to overestimate the presence of non-timber species that grow in ecologically restricted habitat niches and that have sparse, although widespread distributions. These baseline inventory gaps and other model assumptions yielded, on average, low model accuracy for predicting occurrence and abundance of non-timber species. Accurate estimates of conservation status require both more data on the geographic patterns of genetic diversity in natural populations for non-timber species, and landscape modeling that considers site factors at scales that significantly influence distributions, such as site series.

As work continues to refine the approach to evaluating the conservation status of BC's indigenous species, priorities for conservation efforts will be adjusted accordingly. *Ex situ* conservation comprised of seed collections from natural stands is focusing first on species and populations with identified conservation priorities, namely whitebark pine, limber pine, and subalpine larch, and filling in conservation gaps with other species as opportunities and resources allow. Over 8,000 seed samples from 33 indigenous tree species are now in storage at the MFLNRO Provincial Tree Seed Centre.

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[3] Chourmouzis, C., A. D. Yanchuk, A. Hamann, P. Smets, and S. N. Aitken. 2009. Forest tree genetic conservation status report 1: *In situ* conservation status of all indigenous British Columbia species. Centre for Forest Conservation Genetics, Forest Genetics Council of B.C., and B.C. Min. For. Range, For. Sci. Prog. Victoria, B.C. Tech. Rep. 053.

[4] Krakowski, J., C. Chourmouzis, A.D. Yanchuk, D. Kolotelo, A. Hamann, and S.N. Aitken. 2009. Forest tree genetic conservation status report 2: genetic conservation status of operational tree species. Centre for Forest Conservation Genetics, Forest Genetics Council of British Columbia, and B.C. Min. For. Range, For. Sci. Prog. Victoria, B.C. Tech. Rep. 054.

Feature

Assisted Migration Adaptation Trial (AMAT)

Climate is the primary determinant of ecosystem pattern (i.e., biogeoclimatic zones). Many years of genecology research in BC and elsewhere show that genetic diversity patterns of forest tree species are also strongly correlated with climate. In broad terms, seed transfer zones for tree planting in BC are aligned with climate patterns. As climates change, these seed transfer zones must also change to ensure that planted trees are genetically well adapted to the area in which they are planted. With some 240 million seedlings planted in BC each year, this is an important consideration with very long-term implications for forest health, timber supply, and the economic well-being of many communities across the province.

Forests are adapted to the climates in which they grow. West Chilcotin, BC *(J. Woods photo)*

In response to the challenge of better understanding linkages between climate and tree genetic adaptation, scientists from the MFLNRO Tree Improvement Branch lead genecology research for a wide variety of tree species in BC. A new approach to this research was initiated by Dr. Greg O'Neill. He and others are testing multiple species planted on a large number and wide range of test sites. These tests will offer unprecedented ability to accurately predict growth in current and future climates for a wide range of species and genetic populations. Known as the Assisted Migration Adaptation Trial (AMAT), this ambitious research project has garnered significant media interest, including a feature by the Canadian Broadcasting Corporation's 'The National' and *Nature* magazine.

Map produced by M. Leroy

The objective of AMAT is to help maintain resilient and productive forests by better understanding the growth and health of reforestation seed sources used across a range of climates and latitudes in BC. Information from the trial will help identify the species and seed sources best adapted to present and future climates. With the overwhelming majority of climatologists predicting significant warming trends, it is important that planted trees are genetically suited not only to current climates, but also to climates they will experience 50-100 years from now. The AMAT will provide information on climate tolerances for commercially-planted tree species and for a wide range of genetic populations within each species.

The AMAT includes forty-eight seed sources from 15 tree species originating from BC and the north-west United States. They are being planted and monitored at 48 field-test locations between the southern Yukon and northern California. Twelve field-test sites are being planted in each of 4 years, starting in 2009. Growth and health will be assessed every 5 years, and these data will be analyzed to understand climate-genotype relationships. The ClimateBC model (developed by the UBC Centre for Forest Conservation Genetics and supported by funds through the FGC) will be used to support data analysis and to link tree growth and health with predicted future climates. Ultimately, the AMAT will be a strong contributor to the development of climate-based seed transfer in BC, an objective of the FGC. See http://www.for.gov.bc.ca/hre/forgen/interior/AMAT.htm for more information.

Lodgepole pine grown from seed collected at low (left), mid, and high elevation (right) sources and planted in a common garden at lower elevation. Growth differences reflect genetic adaptation of sources to climate *(M. Carlson photo)*

3.4 Climate-based seed transfer

Objective

By 2020, high-quality genecology[5] research information will guide operationally efficient climate-based seed transfer policy and practice for all trees planted in BC.

Performance

Genecology research continues to lead further development of climate-based seed transfer systems. This research is key to meeting the above objective, and includes trials such as AMAT (see page 12), the ClimateBC model, existing long-term field-based genecology trials such as the Douglas-fir submaritime trial and the interior spruce climate-change / genecology trial, and new field trials to supplement areas and species for which current data are inadequate.

The ClimateBC model was developed by the UBC Center for Forest Conservation Genetics and has been partially supported by funding through the FGC. This model provides a means to quantify past climate data and to project climate trends based on the output of major global-circulation models, and has proved to be an indispensible tool for genecology and climate-change research. Understanding and interpreting these complex data sources in the context of forest ecosystems and the movement of seed in BC requires people with substantial scientific expertise and experience.

Development of an administrative system for climate-based seed transfer in BC continues. This complex work will focus on genecology research, while also developing the policy and administrative tools needed to ensure that the users of seed are able to adjust seed inventories, order seedlings, and proceed with planting efficiently. Options for a new administrative system for climate-based seed transfer are under development and will impact operational seed transfer and use in coming years. Future FGC Annual Reports will provide metrics describing the percentage of provincial planting completed under new standards for climate-based seed transfer.

Lodgepole pine orchard operated by Pacific Regeneration Technologies Ltd in conjunction with SelectSeed Ltd. and producing seed for the Thompson Okanagan seed zone *(J. Woods photo)*

[5] Genecology is the study of the geographic distribution of genetic differences among tree populations.

Feature

Developing browse-resistant western redcedar

The unique wood properties of western redcedar make it one of the most valuable timber species in BC. However, as a preferred browse species for ungulates, particularly deer, the cost of protecting newly-planted seedlings is very high in many areas. With over 6 million planted annually on the coast, this is an expensive problem that both adds cost to stand establishment and reduces timber supply through delayed regeneration.

Observed differences in the preference by deer for individual trees led Dr. John Russell (MFLNRO Tree Improvement Branch) to begin research on the inherent degree to which individual trees are preferred and avoided by deer. Studies show that high monoterpene levels are the primary reason for browse avoidance. These levels vary substantially between trees and research has shown that it is a highly heritable trait (passed from parent to offspring). In addition, monoterpene levels are not correlated with growth rate. By selecting trees with high monoterpene levels, there is strong evidence that deer will shift their browsing to other plants that are more palatable. This research is currently in a field-testing phase to better understand how selection for browse resistance will impact stand establishment under normal plantation conditions.

As a result of this innovative research, the prospect for developing seed orchards which will produce operational seedlots with higher levels of browse-resistance is very promising. The seed is unlikely to stop all browsing in areas with large deer populations, but it will improve the rate at which planted trees are able to grow past the height where they are susceptible to browsing. This research is adding another tool for silviculturists to reduce costs and improve success in coastal forest operations.

Photos:
Top: Western redcedar in the Cowichan Valley *(J. Woods photo)*
Lower left: Mule deer *(J. Woods photo)*
Lower right: Deer in a fenced enclosure planted with redcedar that has varying levels of browse resistance (J. Russell photo)

3.5 Coordinate stakeholder activities

Objective

Coordinate stakeholder activities and secure the resources needed to meet Business Plan priorities

Performance

During the period of this report, the FGC led the completion of the following:

- Activity plan and associated budget recommendations for the Land Base Investment Strategy Tree Improvement Program for 2011/12
- A published Business Plan and full set of species plans for 2010/11
- Published FGC Annual Report and Projects Report for 2009/10
- Discussion with MFLNRO executive regarding resourcing needs for the provincial tree improvement program
- Ongoing management of subcommittee work and collaboration on issues.

Council met four times during the fiscal year. These meetings, in combination with subcommittee work done under the overall FGC structure, resulted in the efficient coordination of activities among a broad range of stakeholders that included the MFLNRO, major licensees, smaller licensees, universities, the Canadian Forest Service, other provincial ministries, and non-licensee private firms. Activities included policy recommendations and business planning for tree breeding programs, genecology research, seed orchard operations, genetic conservation, cone and seed pest management, extension, and systems for coordinating seed use information and seedling orders. In addition, Council elected members to the board of directors of Council-owned SelectSeed Ltd. and oversaw SelectSeed operations and financial reporting.

Class A western redcedar seedlings being grown at Western Forest Products Saanich Forestry Centre nursery. *(J. Woods photo)*

3.6 Monitor and report progress

Objective

Monitor and report progress in genetic resource management activities

Performance

This objective was met through the development and publication of a comprehensive Business Plan for 2010/11 and "species plans" that outline breeding programs, seed orchards, historic seed use and production, and other data relevant to an efficient multi-stakeholder provincial program. Performance indicators for objectives set out in the FGC Strategic Plan are reported in this document. Project level reporting is summarized in the Tree Improvement Project Report for 2010/11.

Reporting is also carried out through verbal presentations to a wide variety of stakeholder groups, conferences, meetings, and to managers with program oversight.

Table 2
Number of seed orchards and ramets established by site and owner.

Site and owner[6]	Number of seed orchards	Total #of ramets established	Ramets under contract with SelectSeed Ltd.
Vernon Seed orchard Company Ltd. (including Quesnel orchards)	16	32,213	8,808
Kalamalka Seed orchards (MFLNRO)	17	21,854	
Skimikin Seed Orchards (MFLNRO)	13	18,059	
Pacific Regeneration Technologies Ltd.	6	11,247	7,850
Kettle River Seed Orchards Ltd.	2	7,909	7,909
TimberWest Forests Ltd.	11	5,923	
Tolko Ltd.	3	5,014	5,014
Sorrento Nurseries Ltd.	2	4,873	4,873
Western Forest Products Inc.	12	3,820	
Prince George Tree Improvement Stn. (MFLNRO)	3	3,290	
Saanich Seed Orchards (MFLNRO)	5	3,040	
Canadian Forest Products Ltd.	6	2,193	
Small private (2 sites)	4	1,821	
Bowser Seed Orchards (MFLNRO)	2	1,122	
Total	102	122,378	34,454

[6] Excludes yellow cedar hedge orchards for rooted cutting production owned by Western Forest Products Inc. and the MFLNRO, Cowichan Lake Research Station.

4.0 2010 Orchard Seed Crops

Cone and seed production in 2010 from all orchards listed in Table 2 resulted in large crops of interior and Sitka spruce with continued increases in lodgepole pine crops. Other species had modest seed production, down from the large harvest of 2009 due to natural cone production cycles. Lodgepole pine orchards again had acceptable seed set (filled seeds per cone), although generally below 2009 levels.

Overall, the total harvest of 2,478 kilograms of seed is sufficient to grow approximately 347 million seedlings (Table 2), with the bulk of this being interior spruce. Shortfalls in orchard seed from lodgepole pine and interior Douglas-fir continue to limit the use of high-genetic-worth seed in some seed zones. Figures 5 and 6 show orchard seed production by year and species.

Table 3
Summary of 2010 seed crops from all provincial orchards.

Species	Seed produced (kg)	Seedling equivalents (million)
Interior spruce	1682	253.4
Lodgepole pine	251	33.6
Western larch	97	8.8
Interior Douglas-fir	61	2.5
White pine	85	1.4
Western redcedar	3	1.0
Sitka spruce	41	7.4
Coastal Douglas-fir	21	0.8
Western hemlock	10	1.9
Total	2,478	347.2

Figures 5 and 6
Orchard seed production by year for interior spruce and for all species, excluding interior spruce.